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Implementation of Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) in Recommendations for New Position in Companies

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Abstract

This study aims to provide support to management in recommendations for promotion of employee promotions, with the aim of providing motivation to employees. The problem encountered at this time is the number of employees making it difficult for management to choose employees to recommend in promotions for promotions. In this research, the method used is Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) which is a fairly good method in ranking where the best alternative is the alternative that has the closest distance to the best alternative and far from the worst alternative. From the research results, it can be concluded that the A5 alternative is the best with a value of 0.748 and can be recommended in a new position promotion at the company.

Keywords: *Employee Performance, Recommendations, TOPSIS Method, DSS*

1. Introduction

Human Resources contained in a company greatly influence many aspects that determine the success of the work of the company. In order to further motivate employees, including providing new job promotions to employees at a certain time period. This will also make competition among employees better. This of course will cause problems for management in making decisions and can have a negative impact on the company. For this reason, it is necessary to make the right and careful decisions in determining new positions for employees. In general, the granting of a new position to a company is given on the recommendation of a superior or work unit of each division, based on work experience, performance appraisal and assessment of an employee's behavior in carrying out his duties. For this reason, a decision support system is needed for management in processing employee appraisal data that can help provide support to management to make a decision.

In each company, each position is an organizational position or identity designed to facilitate organizational achievement. In general, recommendations for new positions at companies are made if there are departments that need replacements or are still lacking in filling positions, and are given on the recommendation of their respective superiors or work units based on length of work, behavior assessment, performance appraisal and education of an employee. However, the number of employees in each of these sections will make it difficult for the company to make its choice. From these problems, a Decision Support System (SPK) is needed in providing recommendations for new positions. SPK in this case helps management in appraising employee performance. Decision support systems are computer-based information systems that are able to solve problems with management [1]–[3].

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The development of SPK is currently quite fast, many studies have discussed in this field of study. Not only in the technical field, in the field of management there are also many decision support systems implemented. Some of the methods used include Simple Additive Weighting (SAW) which is used to provide employee incentives [4], selection of campus ambassadors [5], Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) which is used in management decision making [6], selection of the best employees [7], Weighted Product (WP) , Weighted Aggregated Sum Product Assessment (WASPAS) used in the best graduates [8], in providing single tuition scholarships [9].

In this study, the author aims to provide recommendations to management on recommendations for new positions at the company so that it makes it easier for leaders to make decisions. From related research, the writer is interested in using the TOPSIS method in ranking. The TOPSIS method provides an excellent solution in providing the best results, where the best alternative is the closest alternative to the best solution and far from the worst solution [6], [10].

2. Research Methodology

2.1. Research Stages

There are several stages that the writer did in the research, namely:

a) Field Study
   At this stage the authors took some data on the company, including alternative data and criteria.
b) Literature review
   In this section, the authors search for literatures related to the topics discussed, especially regarding the methods used in research.
c) Analysis and Application of Methods
   After knowing how the TOPSIS method works, in this section the authors analyze and apply the method to recommendations for new positions at the company.
d) d. Making Conclusions
   The final stage of the research draws conclusions from the results of the research conducted.

2.2. Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) Method

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is a very well-known method, which was developed by Yoon and Hwang in 1981. The working principle of this method tries to rank alternatives by comparing with the best and farthest solutions. The best alternative is the closest alternative to the best and far from the worst [11]–[13]. The steps for implementing the TOPSIS method[2], [14], namely:

a) Forming a decision matrix (Xij)
b) Forming a Normalized (Rij) matrix
c) Calculating the Weighted Normalized matrix (Yij).
d) Determine the ideal solution positive and negative ideal solution.
e) Calculating the distance between the positive ideal solution and the negative ideal solution.
f) Calculate the preference value for each alternative

In the TOPSIS method, the highest preference value is the value of the best alternative.

3. Result and Discussion

A promotion in employment is one of the company's efforts to motivate its employees. This aims to provide appreciation for employees who have the best performance among the many employees in the company. In this study, the authors set several criteria which are used as recommendations for promotion to work. The following are the criteria for a recommendation for a job position:

C_1 = Working Experience

C_2 = Performance Assessment
C_3 = Behavior Assessment
C_4 = Level of Education
C_5 = Communication Skills

The 10 alternative employees studied in this study are shown in table 1. The table also shows the value of the criteria for each employee studied.

Table 1. Alternative value in each criterion

Alternative	Criteria				
	C_1	C_2	C_3	C_4	C_5
A_1	3 years	Very Good	Good	High School	Good
A_2	3 years	Good	Enough	Diploma	Enough
A_3	2 years	Enough	Poorly	Bachelor's Degree	Enough
A_4	4 years	Very Good	Good	Diploma	Good
A_5	5 years	Good	Enough	Bachelor's Degree	Enough
A_6	3 years	Very Good	Enough	High School	Poorly
A_7	3 years	Good	Good	Diploma	Good
A_8	2 years	Good	Poorly	Bachelor's Degree	Poorly
A_9	4 years	Very Good	Good	High School	Good
A^{10}	2 years	Enough	Enough	Bachelor's Degree	Enough

Table 1 above shows the values of linguistic values such as Very Good, Good, Enough, Poorly, High School, Diploma, Bachelor's Degree which require simple weighting. The weighting of these alternative values can be seen in table 2 below.

Table 2. Weighted Alternative Value

Criteria and Value	Description	Weight Value
Working Experience (C_1)	2 years	1
	3 years	2
	4 years	3
	5 years	4
	>5 years	5
Level of Education (C_4)	High School	1
	Diploma	2
	Bachelor's Degree	3
	Master	4
	Doctor	5
Performance Assessment (C_2), Behavior Assessment (C_3), Communication Skills (C_5),	Not Good	1
	Poorly	2
	Enough	3
	Good	4
	Very Good	5

The weights (W) for each criterion are:

Table 3. Criterion Weights

Criteria	Weighted
Working Experience (C_1)	4
Performance Assessment (C_2)	5
Behavior Assessment (C_3)	4
Level of Education (C_4)	3
Communication Skills (C_5)	4

In table 1, the data has not been weighted, so using table 2 is weighted which results in data that is ready to be processed (calculated) as shown in table 4 below.

Table 4. Match Rating

Alternative	Criteria				
	C_1	C_2	C_3	C_4	C_5
A_1	2	5	4	1	4
A_2	2	4	3	2	3
A_3	1	3	2	3	3
A_4	3	5	4	2	4
A_5	4	4	3	3	3
A_6	2	5	3	1	2
A_7	2	4	4	2	4
A_8	1	3	2	3	2
A_9	3	5	4	1	4
A^{10}	1	3	3	3	3

After the research data is complete to be processed, at the following stage the writer uses the TOPSIS method to rank the research data. The stages of the TOPSIS method can be seen below.

Stage 1: After obtaining the suitability rating data shown in table 4, a decision matrix (Xij) is formed based on the table. The decision matrix (Xij) can be seen below.

$$X=\begin{bmatrix} 2 & 5 & 4 & 1 & 4 \\ 2 & 4 & 3 & 2 & 3 \\ 1 & 3 & 2 & 3 & 3 \\ 3 & 5 & 4 & 2 & 4 \\ 4 & 4 & 3 & 3 & 3 \\ 2 & 5 & 3 & 1 & 2 \\ 2 & 4 & 4 & 2 & 4 \\ 1 & 3 & 2 & 3 & 2 \\ 3 & 5 & 4 & 1 & 4 \\ 1 & 3 & 3 & 3 & 3 \end{bmatrix}$$

Stage 2: Then from the decision matrix (Xij) a normalized matrix (Rij) is formed using the following equation:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} {x_{ij}}^2}} \quad (1)$$

The following calculations are carried out to form a normalized matrix

$|X_1| = \sqrt{(2)^2 + (2)^2 + (1)^2 + (3)^2 + (4)^2 + (2)^2 + (2)^2 + (1)^2 + (3)^2 + (1)^2} = 7{,}280$

$|X_2| = \sqrt{(5)^2 + (4)^2 + (3)^2 + (5)^2 + (4)^2 + (5)^2 + (4)^2 + (3)^2 + (5)^2 + (3)^2} = 13{,}229$

$|X_3| = \sqrt{(4)^2 + (3)^2 + (2)^2 + (4)^2 + (3)^2 + (3)^2 + (4)^2 + (2)^2 + (4)^2 + (3)^2} = 10{,}392$

$|X_4| = \sqrt{(1)^2 + (2)^2 + (3)^2 + (2)^2 + (3)^2 + (1)^2 + (2)^2 + (3)^2 + (1)^2 + (3)^2} = 7{,}141$

$|X_5| = \sqrt{(4)^2 + (3)^2 + (3)^2 + (4)^2 + (3)^2 + (2)^2 + (4)^2 + (2)^2 + (4)^2 + (3)^2} = 10{,}392$

After getting the Xn value, then you must complete the Rij formula as follows:

R_{11}=2/7,280=0,274 R_{21}=5/13,229=0,378 R_{31}=4/10,392=0,385 R_{41}=1/7,141=0,140

R_{12}=2/7,280=0,274 R_{22}=4/13,229=0,302 R_{32}=3/10,392=0,289 R_{42}=2/7,141=0,280

R_{13}=1/7,280=0,137 R_{23}=3/13,229=0,227 R_{33}=2/10,392=0,192 R_{43}=3/7,141=0,420

R_{14}=3/7,280=0,412 R_{24}=5/13,229=0,378 R_{34}=4/10,392=0,385
R_{44}=2/7,141=0,280
R_{15}=4/7,280=0,549 R_{25}=4/13,229=0,302 R_{35}=3/10,392=0,289
R_{45}=3/7,141=0,420
R_{16}=2/7,280=0,275 R_{26}=5/13,229=0,378 R_{36}=3/10,392=0,289
R_{46}=1/7,141=0,140
R_{17}=2/7,280=0,275 R_{27}=4/13,229=0,302 R_{37}=4/10,392=0,385
R_{47}=2/7,141=0,280
R_{18}=1/7,280=0,137 R_{28}=3/13,229=0,227 R_{38}=2/10,392=0,192
R_{48}=3/7,141=0,420
R_{19}=3/7,280=0,412 R_{29}=5/13,229=0,378 R_{39}=4/10,392=0,385
R_{49}=1/7,141=0,140
R_{110}=1/7,280=0,137 R_{210}=3/13,229=0,227 R_{310}=3/10,392=0,289
R_{410}=3/7,141=0,420

R_{51}=4/10,392=0,385
R_{52}=3/10,392=0,289
R_{53}=3/10,392=0,289
R_{54}=4/10,392=0,385
R_{55}=3/10,392=0,289
R_{56}=2/10,392=0,192
R_{57}=4/10,392=0,385
R_{58}=2/10,392=0,192
R_{59}=4/10,392=0,385
R_{510}=3/10,392=0,289

Stage 3: Then calculate the weighted normalized matrix (Yij) using equation 2. For the weight that has been determined (W)=[4,5,4,3,4]

$$v_{ij} = w_j . r_{ij} \quad (2)$$

The following is the calculation to get a weighted normalized matrix (Yij).

R_{11}=4*0,275=1,096 R_{21}=5*0,378=1,890 R_{31}=4*0,385=1,540
R_{41}=3*0,140=0,420
R_{12}=4*0,275=1,096 R_{22}=5*0,302=1,512 R_{32}=4*0,289=1,155
R_{42}=3*0,280=0,840
R_{13}=4*0,137=0,549 R_{23}=5*0,227=1,134 R_{33}=4*0,192=0,770
R_{43}=3*0,420=1,260
R_{14}=4*0,412=1,648 R_{24}=5*0,378=1,890 R_{34}=4*0,385=1,540
R_{44}=3*0,280=0,840
R_{15}=4*0,549=2,198 R_{25}=5*0,302=1,512 R_{35}=4*0,289=1,155
R_{45}=3*0,420=1,260
R_{16}=4*0,275=1,096 R_{26}=5*0,378=1,890 R_{36}=4*0,289=1,155
R_{46}=3*0,140=0,420
R_{17}=4*0,275=1,096 R_{27}=5*0,302=1,512 R_{37}=4*0,385=1,540
R_{47}=3*0,280=0,840
R_{18}=4*0,137=0,549 R_{28}=5*0,227=1,134 R_{38}=4*0,192=0,770
R_{48}=3*0,420=1,260
R_{19}=4*0,412=1,648 R_{29}=5*0,378=1,890 R_{39}=4*0,385=1,540
R_{49}=3*0,140=0,420
R_{110}=4*0,137=0,549 R_{210}=5*0,227=1,134 R_{310}=4*0,289=1,155
R_{410}=3*0,420=1,260

R_{51}=4*0,385=1,540
R_{52}=4*0,289=1,155
R_{53}=4*0,289=1,155
R_{54}=4*0,385=1,540
R_{55}=4*0,289=1,155
R_{56}=4*0,192=0,770
R_{57}=4*0,385=1,540
R_{58}=4*0,192=0,770
R_{59}=4*0,385=1,540
R_{510}=4*0,289=1,155

Stage 4: The next stage determines the Positive Ideal Solution (A^*) (equation 3) and the Negative Ideal Matrix (A^-) (equation 4).

$$A^* = \{(\max_i v_{ij} \mid j \in J), (\min_i v_{ij} \mid j \in J')\} \; i = 1,2,\ldots, m \quad (3)$$
$$= \{v_1^*, v_2^*, \ldots, v_j^*, \ldots, v_n^*\}$$

$$A^- = \{(\min_i v_{ij} \mid j \in J), (\max_i v_{ij} \mid j \in J')\} \; i = 1,2,\ldots,m \quad (4)$$
$$= \{v_1^-, v_2^-, \ldots, v_j^-, \ldots, v_n^-\}$$

At this stage the 3rd equation is used to calculate the ideal positive solution, this is because all the criteria used are with the types of benefits.
A_1^*=max{1.099; 1.099; 0.549; 1.648; 2.198; 1.099; 1.099; 0.549; 1.648; 0.549} = 2.196
A_2^*=max{1.890; 1.512; 1.134; 1.890; 1.512; 1.890; 1.512; 1.134; 1.890; 1.134} = 1.885
A_3^*=max{1.540; 1.155; 0.770; 1.540; 1.155; 1.155; 1.540; 0.770; 1.540; 1.155} = 1.536
A_4^*=max{0.420; 0.840; 1.260; 0.840; 1.260; 0.420; 0.840; 1.260; 0.420; 1.260} = 1.260
A_5^*=max{1.540; 1.155; 1.155; 1.540; 1.155; 0.770; 1.540; 0.770; 1.540; 1.155} = 1.924
v^*={2.198; 1.890; 1.540; 1.260; 1.540}

A_1^-=min{1.099; 1.099; 0.549; 1.648; 2.198; 1.099; 1.099; 0.549; 1.648; 0.549} = 2.196
A_2^-=min{1.890; 1.512; 1.134; 1.890; 1.512; 1.890; 1.512; 1.134; 1.890; 1.134} = 1.885
A_3^-=min{1.540; 1.155; 0.770; 1.540; 1.155; 1.155; 1.540; 0.770; 1.540; 1.155} = 1.536
A_4^-=min{0.420; 0.840; 1.260; 0.840; 1.260; 0.420; 0.840; 1.260; 0.420; 1.260} = 1.260
A_5^-=min{1.540; 1.155; 1.155; 1.540; 1.155; 0.770; 1.540; 0.770; 1.540; 1.155} = 1.924
v^-={0.549; 1.134; 0.770; 0.420; 0.770}

Stage 5: The next step is to find the distance between the positive ideal solution (S_i^*) and the ideal solution (S_i^-) using equations 5 and 6.

$$S_i^* = \sqrt{\sum_{j=1}^{n}(v_{ij} - v_j^*)^2} \quad (5)$$

$$S_i^- = \sqrt{\sum_{j=1}^{n}(v_{ij} - v_j^-)^2} \quad (6)$$

The following is a calculation to find the value of the positive ideal solution distance.
S_1^*=
$\sqrt{(1{,}099-2{,}198)^2 + (1{,}890-1{,}890)^2 + (1{,}540-1{,}540)^2 + (0{,}420-1{,}260)^2 + (1{,}540-1{,}540)^2}$
= 1,383
S_2^*=
$\sqrt{(1{,}099-2{,}198)^2 + (1{,}512-1{,}890)^2 + (1{,}155-1{,}540)^2 + (0{,}840-1{,}260)^2 + (1{,}155-1{,}540)^2}$
= 1,350
S_3^*=
$\sqrt{(0{,}549-2{,}198)^2 + (1{,}134-1{,}890)^2 + (0{,}770-1{,}540)^2 + (1{,}260-1{,}260)^2 + (1{,}155-1{,}540)^2}$
=2.007

S_4^*= $\sqrt{(1{,}648-2{,}198)^2+(1{,}890-1{,}890)^2+(1{,}540-1{,}540)^2+(0{,}840-1{,}260)^2+(1{,}540-1{,}540)^2}$ =0,692

S_5^*= $\sqrt{(2{,}198-2{,}198)^2+(1{,}512-1{,}890)^2+(1{,}155-1{,}540)^2+(1{,}260-1{,}260)^2+(1{,}155-1{,}540)^2}$ = 0,663

S_6^*= $\sqrt{(1{,}099-2{,}198)^2+(1{,}890-1{,}890)^2+(1{,}155-1{,}540)^2+(0{,}420-1{,}260)^2+(0{,}770-1{,}540)^2}$ =1,629

S_7^*= $\sqrt{(1{,}099-2{,}198)^2+(1{,}512-1{,}890)^2+(1{,}540-1{,}540)^2+(0{,}840-1{,}260)^2+(1{,}540-1{,}540)^2}$ = 1,236

S_8^*= $\sqrt{(0{,}549-2{,}198)^2+(1{,}134-1{,}890)^2+(0{,}770-1{,}540)^2+(1{,}260-1{,}260)^2+(0{,}770-1{,}540)^2}$ = 2,115

S_9^*= $\sqrt{(1{,}648-2{,}198)^2+(1{,}890-1{,}890)^2+(1{,}540-1{,}540)^2+(0{,}420-1{,}260)^2+(1{,}540-1{,}540)^2}$ =1,004

S_{10}^*= $\sqrt{(0{,}549-2{,}198)^2+(1{,}134-1{,}890)^2+(1{,}155-1{,}540)^2+(1{,}260-1{,}260)^2+(1{,}155-1{,}540)^2}$ =1.893

The following is the calculation to find the value of the ideal negative solution distance

S_1^-= $\sqrt{(1{,}099-0{,}549)^2+(1{,}890-1{,}134)^2+(1{,}540-0{,}770)^2+(0{,}420-0{,}420)^2+(1{,}540-0{,}770)^2}$ = 1,435

S_2^-= $\sqrt{(1{,}099-0{,}549)^2+(1{,}512-1{,}134)^2+(1{,}155-0{,}770)^2+(0{,}840-0{,}420)^2+(1{,}155-0{,}770)^2}$ = 0,958

S_3^-= $\sqrt{(0{,}549-0{,}549)^2+(1{,}134-1{,}134)^2+(0{,}770-0{,}770)^2+(1{,}260-0{,}420)^2+(1{,}155-0{,}770)^2}$ =0.924

S_4^-= $\sqrt{(1{,}648-0{,}549)^2+(1{,}890-1{,}134)^2+(1{,}540-0{,}770)^2+(0{,}840-0{,}420)^2+(1{,}540-0{,}770)^2}$ =1,772

S_5^-= $\sqrt{(2{,}198-0{,}549)^2+(1{,}512-1{,}134)^2+(1{,}155-0{,}770)^2+(1{,}260-0{,}420)^2+(1{,}155-0{,}770)^2}$ = 1,965

S_6^-= $\sqrt{(1{,}099-0{,}549)^2+(1{,}890-1{,}134)^2+(1{,}155-0{,}770)^2+(0{,}420-0{,}420)^2+(0{,}770-0{,}770)^2}$ =1,011

S_7^-= $\sqrt{(1{,}099-0{,}549)^2+(1{,}512-1{,}134)^2+(1{,}540-0{,}770)^2+(0{,}840-0{,}420)^2+(1{,}540-0{,}770)^2}$ = 1,344

S_8^-= $\sqrt{(0{,}549-0{,}549)^2+(1{,}134-1{,}134)^2+(0{,}770-0{,}770)^2+(1{,}260-0{,}420)^2+(0{,}770-0{,}770)^2}$ = 0,840

S_9^-= $\sqrt{(1{,}648-0{,}549)^2+(1{,}890-1{,}134)^2+(1{,}540-0{,}770)^2+(0{,}420-0{,}420)^2+(1{,}540-0{,}770)^2}$ =1,722

S_{10}^-= $\sqrt{(0{,}549-0{,}549)^2+(1{,}134-1{,}134)^2+(1{,}155-0{,}770)^2+(1{,}260-0{,}420)^2+(1{,}155-0{,}770)^2}$ =1.001

Stage 6: In the final stage, calculate the Preference Value for each alternative using the following equation 7.

$$C_i^* = \frac{S_i^-}{S_i^* + S_i^-} \quad (7)$$

Table 5. Rangking alternative

	Preference Value	Rangking
C_1^*	1,435 / (1,383+1,435) = 0,509	5
C_2^*	0,958 / (1,350+0,958) = 0,415	6
C_3^*	0,924 / (2,007+0,924) = 0,315	9
C_4^*	1,772 / (0,692+1,772) = 0,719	2
C_5^*	1,965 / (0,663+1,965) = 0,748	1
C_6^*	1,011 / (1,629+1,011) = 0,383	7
C_7^*	1,344 / (1,236+1,344) = 0,521	4
C_8^*	0,840 / (2,115+0,840) = 0,284	10
C_9^*	1,722 / (1,004+1,772) = 0,632	3
C_{10}^*	1,001 / (1,893+1,001) = 0,346	8

Table 5 above shows the preference value that has been processed and has been ranked among 10 employees, while the highest employee is A5 with a preference value of 0.748. The employee with the highest preference value is the employee with the best performance value and can be recommended for promotion to promotion to the company.

4. Conclusion

The results of research conducted that the application of TOPSIS in providing recommendations for positions at work is able to provide results that the 4th alternative has the highest value with a value of 0.748 and it can be said that A5 can be recommended for new job positions. The application of TOPSIS is able to provide better decision results, as a supporter of the leadership in making the right decisions. The application of the TOPSIS method is proven to be able to process input data in the form of employee performance data and weight data into an employee performance appraisal process that will be recommended for new positions.

References

[1] Efraim Turban and Jay E. Aronson, *Decision Support System and Intelligent Systems*. 2001.

[2] T. Limbong *et al.*, *Sistem Pendukung Keputusan: Metode & Implementasi*. Medan: Yayasan Kita Menulis, 2020.

[3] D. Nofriansyah and S. Defit, *Multi Criteria Decision Making (MCDM) pada Sistem Pendukung Keputusan*. 2018.

[4] S. H. Sahir, R. Rosmawati, and K. Minan, "Simple Additive Weighting Method to Determining Employee Salary Increase Rate," *Int. J. Sci. Res. Sci. Technol.*, vol. 3, no. 8, pp. 42–48, 2017.

[5] I. Judi, T. Situmeang, S. Hummairoh, and S. M. Harahap, "Application of SAW (Simple Additive Weighting) for the Selection of Campus Ambassadors," *IJICS (International J. Informatics Comput. Sci.*, vol. 5, no. 1, pp. 21–28, 2021.

[6] G. Ginting, Fadlina, Mesran, A. P. U. Siahaan, and R. Rahim, "Technical Approach of TOPSIS in Decision Making," *Int. J. Recent Trends Eng. Res.*, vol. 3, no. 8, pp. 58–64, 2017.

[7] Jasri, D. Siregar, and R. Rahim, "Decision Support System Best Employee Assessments with Technique for Order of Preference by Similarity to Ideal Solution," *Int. J. Recent TRENDS Eng. Res.*, vol. 3, no. 3, pp. 6–17, 2017.

[8] S. M. Harahap, I. Judi, T. Situmeang, and S. Hummairoh, "Implementation of Weighted Aggregated Sum Product Assessment (WASPAS) in Determining the Best Graduates," *IJICS (International J. Informatics Comput. Sci.*, vol. 5, no. 1, pp. 44–51, 2021.

[9] N. K. Daulay, B. Intan, and M. Irvai, "Comparison of the WASPAS and MOORA Methods in Providing Single Tuition Scholarships," *IJICS (International J. Informatics Comput. Sci.*, vol. 5, no. 1, pp. 84–94, 2021.

[10] R. Khorshidi and A. Hassani, "Comparative analysis between TOPSIS and PSI methods of materials selection to achieve a desirable combination of strength and workability in Al/SiC composite," *Mater. Des.*, vol. 52, no. June, pp. 999–1010, 2013.

[11] S. Kusumadewi, S. Hartati, A. Harjoko, and Retantyo Wardoyo, *Fuzzy Multi-Attribute Decision Making (FUZZY MADM)*. 2006.

[12] K. D. Maisari, D. Andreswari, and R. Efendi, "Implementasi Metode TOPSIS dengan Pembobotan Entropy untuk Penentuan Calon Penerima Bantuan Siswa Miskin (BSM) APBD Kota Bengkulu(Studi Kasus : SMAN 8 Kota Bengkulu)," *J. Rekursif*, vol. 5, no. 2, pp. 179–194, 2017.

[13] Y. Zai, M. Mesran, B. Nadeak, and I. Saputra, "Penerapan Technique For Orders Preference By Similarity To Ideal Solution (Topsis) Untuk Keputusan Pemberian Kredit Pada Calon Nasabah (Studi Kasus : PT. SS Finance)," *MEDIA Inform. BUDIDARMA*, vol. 1, no. 1, Feb. 2017.

[14] S. Syamsudin and R. Rahim, "Study Approach Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS)," *Int. J. Recent Trends Eng. Res.*, vol. 3, no. 3, pp. 268–285, 2017.